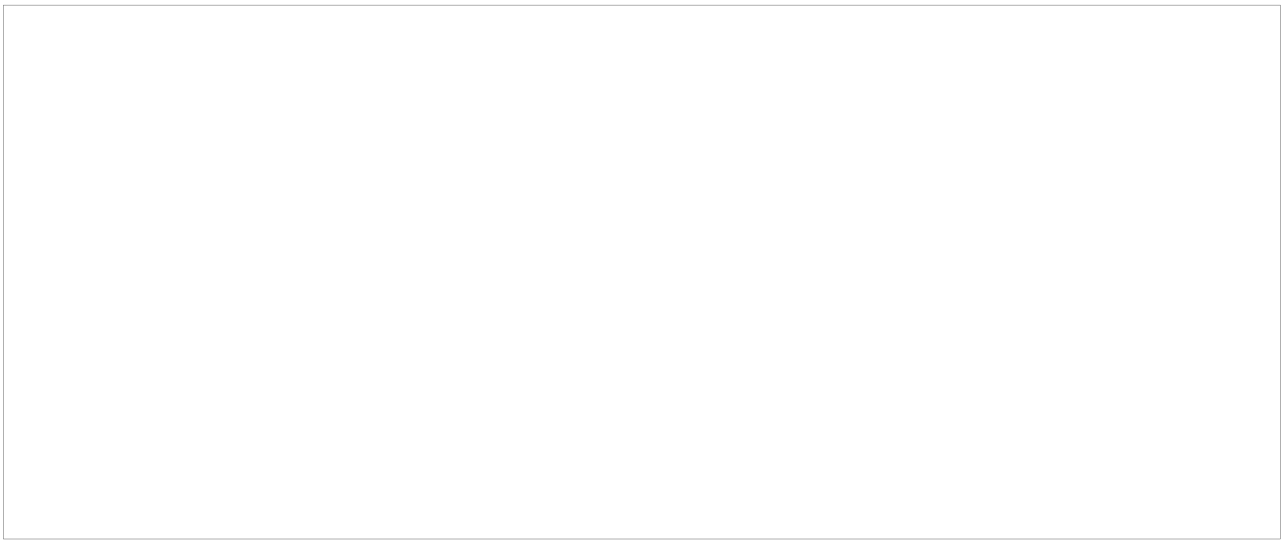

MANUAL OF PONTON BRIDGE BUILDING, VOLUME II

CONFIDENTIAL

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Helsinki, 1942, by

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Introduction:

The basis for the science of ponton bridge building is good personal instruction. Each engineer soldier and officer, non-commissioned or commissioned, must understand the methods and equipment used, so that they can work independently, swiftly, and expediently.

The training program at the regular training camp is filled with practice in handling vehicles and in building ponton bridges, under variable conditions. Particular emphasis is placed on training to travel on the water and to build ponton bridges at night.

The figures given in the manual for the strengths of the units and squads required to accomplish various tasks are the smallest possible but when the different duties are assigned, it is important to avoid breaking up the organizational units, subordinate units or squads.

The commands for carrying out the simplest, routine duties are described in the manual. As the training progresses the use of signals is introduced. Under conditions in the field, however, the rules laid down in the manual are to be used solely as a guide, with adaptations to fit the circumstances. Any method which helps to expedite the accomplishment of the mission is permissible.

During training maneuvers on the water, it is the responsibility of the instructor to see that the prescribed safety precautions are carried out. On this score, it is important that these safety pre-

cautions are carried out. On this score, it is important that these safety precautions, which are designed for training maneuvers in swift currents, should also be observed in practice exercises in slack currents in order that they may become thoroughly ingrained. (By swift current is meant anything over 1.5 meters per second. See Appendix 7.) Footnote from page 14.

MANUAL OF PONTON BRIDGE BUILDING--VOLUME II

Chapter One--General Information

A. Description and Use of Ponton Bridge Equipage M/35.

1. With their equipment, a bridge company can build bridges, rafts, or landing stages. The approximate dimensions of the various bridges that can be built, including in each case a trestle on each shore, are given in the following table: (See also Appendix 1).

Carrying Capacity of Bridge, Tons	Number of Platoons	Approximate Length of Bridge, Meters	Remarks
4.5	1	60-68	
7	1	44-48	
12	1	36-40	
4.5	2	100-116	Two extra trestle spans
7	2	68-80	" " " "
12	2	52-68	" " " "
4.5	3	148-164	Four extra trestle spans
7	3	100-112	" " " "
12	3	76-84	" " " "

2. A ponton bridge consists of two sections, a fixed part and a floating part. The fixed section includes the abutment span, the supporting abutment sill and trestle, and the trestle span and its supporting trestle. The floating section consists of the float-

ing spans and the supporting pontons. The fixed section is connected to the floating section either with a "seka" span [See page 38 for def.] supported on the in-shore end by an abutment sill or a transom, and on the other end by a ponton,--or with a hinge span which is supported on the in-shore end by either an abutment sill or a trestle and on the other end by a floating span.

The bridge bed, which is attached to the supporting members, consists of the bunk (1-) beams, the transverse balks, the (longitudinal) balks, the chess, and the siderail equipage.

A trestle bridge is one having only trestles.

The floating section of a ponton bridge is generally built a span at a time, whereby the floating spans arrive at the bridge site already assembled; in exceptional cases the spans are assembled at the bridge head, being put together one balk-length of the span at a time. (See Sections 178-182).

When the floating spans are used for ferrying they are referred to as rafts.

That section of the bridge, starting at the abutment sill, which is anchored to the shore, is known as the shore-bridge.

The width of the roadway across the bridge is 290 centimeters, except on the hinge span, where it is 285 centimeters.

3. On ponton bridges of 4.5, 7, or 12 ton capacity, vehicles weighing these respective amounts may cross. On two-axle vehicles the heavier axle can not weigh more than 70 percent of the total weight of the vehicle, i.e. 3.2, 4.9, or 8.4 tons, respectively, for the 4.5, 7, or 12 ton bridges. The total allowable weight of single-axle vehicles is also 3.2, 4.9, and 8.4 tons, respectively, on the 4.5, 7, and 12 ton bridges.

In crossing a ponton bridge, vehicles whose individual weights correspond to the capacity of the bridge must follow each other at a distance not less than eight meters, or a distance equal to the length of one floating span. Vehicles whose individual weights are not more than one half of the capacity of the bridge, may cross the bridge spaced according to their usual line of march.

The maximum speed limit on ponton bridges is generally 12 kilometers per hour; on a 12-ton bridge, the speed limit for vehicles weighing from 7 to 12 tons is 8 kilometers per hour, except during unfavorable conditions, when it is 4 kilometers per hour. (See Section 4).

4. During unfavorable conditions such as strong winds, heavy waves, or a strong or indirect current, the freeboard, which in no case should be less than 25 centimeters, may not be sufficient for the particular capacity of the bridge. Under these circumstances, it becomes advisable to consider lowering the load limits, as for example, so that the following would apply:

	Load Limit, Tons
4.5 ton bridge or raft:	3
7 ton bridge or raft:	4.5
12 ton bridge or raft:	7

Alternatively, the speed limits may be lowered a corresponding amount.

The bridge officer will issue the necessary orders covering this situation and will see that they are carried out.

5. The abutment span and the trestle span are each six meters long and the "seka" span and the floating span are each eight meters

meters long. The floating span supporting the hinge span (whose balk length is 645 centimeters) on a 4.5 or 7 ton bridge can be moved 465 centimeters, and on a 12 ton bridge 385 centimeters. Under exceptional circumstances it is possible to make the abutment spans and floating spans four and six meters long.

6. The structure of the spans consists of the following:

a). In the standard 4.5 ton bridge, the various spans are comprised of the following equipage:

—Abutment span and trestle span: Each have one transverse balk. (See Figure 91).

—The "seka" span: One ponton and two transverse balk.. (See Figure 107).

—Floating span (deck section): two pontons, and one transverse balk. (See Figure 98).

—Floating span supporting a hinge span: three pontons and one transverse bulk (Figures 121a and 121b); all these spans have simple side beams and simple chess.

Each span has eight balks.

b). In the standard 7 ton bridge, the various spans include the following equipage:

—Abutment span and trestle span: each have two transverse balk. (See Figure 92).

—The "seka" span: either two pontons and one transverse balk, (Figure 110) or,

one ponton and two transverse balk.. (See Figure 111). (One ponton is generally used when the depth of water is less than 85 centimeters, which is too shallow for two pontons.) [Footnote from page 18]

--Floating span (deck section): three pontons (Figure 100), or four pontons if the adjacent "seka" span has only one ponton. (Figure 111).

--Floating span supporting a hinge span: four pontons. (Figure 122).

Each span has simple side beams and simple chess. There are eight balk on each span.

c). In the standard 12 ton bridge, the spans are comprised of the following equipage:

--Abutment span and trestle span: four transverse balk. (two pairs). (Figure 93).

--The "seka" span: two pontons and four transverse balk (two pairs) (Figure 114) or,

one ponton and six transverse balk (in pairs) (Figure 115). (One ponton is generally used when the depth of water is less than 85 centimeters, which is too shallow for two pontons; however, when one ponton is used the freeboard at the joint where the "seka" span and the floating span come together is only 22-23 centimeters), [Footnote from page 19.] or,

three pontons and two transverse balk (Figure 116). (Three pontons are used when there is a shortage of transverse balk). [Footnote from page 19.]

--Floating span (deck section): four pontons (Figure 116), or five pontons, if the adjacent "seka" span has only one ponton. (Figure 115).

--Floating span supporting a hinge span: five pontons. (Figure 124).

Each of the spans has double side beams, double chess, and eight balk.

The special four-meter floating span has:

a). On the 4.5-7 ton bridges: two pontons (Figure 105).

b). On the 12 ton bridge: two pontons, double side-beams and double chess.

The special six-meter "seka" span has:

a). On the 4.5 ton bridge: One ponton and one transverse balk (Figure 109).

b). On the 7 ton bridge: two pontons and one transverse balk (Figure 112), or

one ponton and two transverse balk, in which case the adjacent floating span must have four pontons (Figure 113).

c). On the 12 ton bridge: two pontons, two transverse balk (as a pair), double side-beams and double chess (Figure 117), or

one ponton, four transverse balk (in pairs), in which case the adjacent floating span must have five pontons (Figure 118), and double side-beams and double chess. (When one ponton is used, the freeboard at the joint where the "seka" span and the floating span come together is only 22-23 centimeters). [Footnote from page 20.]

The special six-meter floating span has:

a). On the 4.5 ton bridge: two pontons.

b). On the 7 ton bridge: two pontons and one transverse balk (Figure 101), or

three pontons (Figure 104).

c). On the 12 ton bridge: three pontons, double side-beams and double chess.

The construction of the deck on all the bridges is the same. On the 4.5 ton bridge and the 7 ton bridge one hinge span can be adjusted a maximum of 465 centimeters and on the 12 ton bridge a maximum of 385 centimeters; when two hinge spans are used the bridge can generally be closed up.

The bridge can be lengthened or shortened at the central couplings of the spans about 20 centimeters per span for a maximum of 20 spans, but before this is done the bunk lashings must be loosened and after the adjustment of the bridge length they must be made fast again.

On a bridge that has no treatles, it is also possible to lengthen the bridge or to close the gap by moving the abutment sill on either or both shores, either further inland or closer to the shore.

B. Composition of A Bridge Company.

7. A bridge company is a transportation and maintenance organization. It consists of:

--The commanding officer and the Second-in-Command,
--The company headquarters,
--three ponton bridge platoons,
--an assault boat platoon, and
--a services platoon.

The company headquarters includes the following personnel and equipment:

--A squad leader,
--a motor vehicle (for the company commander), and
--two motorcycle messengers (two motorcycles with sidecars).

Each of the three ponton bridge platoons includes:

—a platoon leader,

—a second-in-command,

—a medical corpsman,

—a messenger, and

—a motor vehicle (for the platoon leader).

The bridge builders' shore squad includes:

—the squad leader,

—the abutment span vehicles (2 trucks),

—the "seka" span vehicles (2 trucks),

—the hinge span vehicle, (one truck), and

—the accessory equipment vehicle (one truck).

The three ponton bridge squads include:

—the squad leaders, and

—the vehicles for the pontons (12 trucks).

The engineers squad includes:

—the squad leader, and

—the engineer troops.

The assault boat platoon includes:

—a platoon leader,

—a second-in-command,

—a medical corpsman,

—a messenger,

—a motor vehicle (for the platoon leader),

—a troop transport vehicle (an 18 passenger bus), and

—a vehicle for fuel (one truck).

The three assault boat squads include:

—the squad leaders,

—the assault boat crews, and

—the vehicles for the assault boats (6 trucks).

The services platoon includes:

—the sergeant major,

—a clerk, and

—a non-commissioned medical officer.

The technical squad includes:

—a squad leader,

—an armorer,

—~~an~~ automotive mechanics,

—a blacksmith,

—a repair vehicle (one truck), and

—a fuel vehicle (one truck).

The administrative squad includes:

—a combined supply- and mess sergeant,

—a supply clerk,

—cooks,

—a shoemaker, and

—a kitchen vehicle (one truck).

The commander has the prerogative to modify his organization in any situation to fit the demands of the task at hand or the system of roads.

The company headquarters:

Type of Vehicle	Use
1 Passenger vehicle	Company commander
2 Motorcycles with sidecars	Motorcycle messengers

Each ponton bridge platoon (total of three):

Type of vehicle	Use or load of each vehicle
1 Passenger vehicle	Platoon leader
2 Abutment span trucks	One 4.5 ton abutment span
2 "Seka" span trucks	One-half of a 4.5 ton "seka" span
1 Hinge span trucks	Accessories and repair equipment
1 Accessory equipment truck	One-half of a 4.5 ton floating span
12 Ponton trucks	

Assault boat platoon:

Type of vehicle	Use or load of each vehicle
1 Passenger vehicle	Platoon leader
1 Troop transport truck	Transporting the troops
1 Fuel truck	Fuel, lubricants, distributing equipment, and outboard motor repair equipment
6 Assault boat trucks	Three outboard motors and three assault boats with their equipment

The services platoon:

Type of vehicle	Use or load of each vehicle
1 Repair equipment truck	Ponton and truck repair equipment and towing crane
1 Fuel truck	Fuel, lubricants, and distributing equipment
1 Kitchen truck	Field kitchen and cooking utensils

8. Ponton equipage is generally transported on something close to three-ton trucks.

Each ponton is transported on a special trailer which is coupled to the ponton truck by means of a beam fastened to the bed of the truck. (See Section 10).

The method of loading of the bridge equipage on the vehicles is illustrated in Appendix 4.

The assault boats and their engines with their accompanying equipment are carried on trucks whose beds must be at least four meters long. They are loaded onto an assault boat transporting rack. The sidewalls of the truck may be left in place.

The maximum speed limit for all vehicles carrying equipment is 45 kilometers per hour.

In transporting the equipment by rail, the trailers are loaded separately.

Chapter Two—Detailed Description of the Ponton Bridge Equipage.

A. The ponton and the trailer.

9. A ponton is a craft made of sheet steel and used as a support for a bridge.

Both the bow and the stern have an end-beam, 4 centimeters thick, fastened on to them for protection. When the gunwale on the bow is raised, it is known as a spray rail.

The ribs, together with the gunwals, to which the ends of the ribs are attached, give the hull its shape.

The gunwale has the following holes: two large holes in the bow for the support stock, and between them one small one for an oarlock; on each side two for the bow bollards and two for oarlocks; two holes in the stern for the support stock and between them one for the rudder oarlock; also in the stern, on each side one for the stern bollards and two for oarlocks; amidships there are 12 holes on each side of which the last pair is for the side-beam plugs and the others are for the balk plugs.

To the ribs of the ponton, beams are fastened; to these beams the hangers are attached by their hooks. When they are not in use, the oarlocks are stored in pockets attached to the sides of the ponton. Floorboards protect the bottom of the ponton and facilitate movement in the ponton. There is both in the bow and in the stern, a mooring ring for the mooring line. In the floor of the bow there is a base for the attachment of the capstan support arm. On the forward and aft gunwales there are antifriction rollers over which a chain is used to fasten the ponton to the shaft of the trailer.

The bottom of the ponton is protected on the outside by wooden runners.

On each side of the ponton there are two bollards in the bow and one in the stern. When they are not in use they are stored in a storage space under the gunwale. The bollards are locked in place with a pin which is attached to the ponton by a chain.

Ponton Dimensions:	Meters
Length	7.98
Width at the gunwales	1.55
Width at the bottom	1.33
Height, excluding runners	1.00
Height, including runners	1.05

Draft of ponton in still water, with runners:	Centimeters
Empty	19
With 500 kilogram load	27
" 1000 " "	34
" 1500 " "	40
" 2000 " "	47
" 3000 " "	58
" 4000 " "	68
" 5000 " "	78
" 6000 " "	88

An empty ponton weighs approximately 750 kilograms.

10. A trailer is a single-axle vehicle used to transport pontons. (See Figures 1 and 2). It consists of a frame with an

axle, and a shaft which is detachable from the frame. At the forward and rear ends of the frame, there are sills which rest on wooden blocks. There are fixed projections at the ends of the sills which guide the ponton during loading. On the inside of the frame there are two hangers which are used to fasten the ponton, by means of its beams, to the frame of the trailer. When the trailer is being transported empty, the hangers are placed on the shaft side by side with their curved ends pointing down. The shaft is a steel pipe 4.74 meters long; on one end of it there is a winged fastener which, on being turned 90°, locks the shaft to the frame of the trailer; on the other end of the shaft there is a fork, with holes on the outside for securing it to the timber that is fastened to the bed of the truck. Further back toward the trailer from the fork, along the shaft there is a gunwale lashing with a double-ringed fastener, which is wound around the shaft; when the ponton is to be loaded onto the trailer, this fastener is placed in the cable roller slot in the bow gunwale and locked in place with the roller slot plug which is secured under the bow gunwale with a chain. The greatest width of the trailer is 1.65 meters, the overall length (the shaft) is 4.74 meters, the height of the sills above the ground is about one meter, the width of track is 1.45 meters, the wheel size is 6.00-20, and the maximum allowable load per wheel is 640 kilograms. The weight of the trailer itself is about 270 kilograms and when the weight of the ponton (about 850 kilograms) is added, the total weight is about 1120 kilograms.

11. The trailer spar is a timber 4.80 meters long (See Figure 3), which has an articulated coupling on the outer end for fastening it to the shaft of the trailer. This coupling has grease nipples on it for lubrication of the joint. On the end of the spar to which the

coupling is attached, there is the following sign painted on both sides of the spar: "This section extends over the end of the truck bed", and there is also a vertical line beside the sign to indicate how much of the spar should jut out over the truck bed, in order that the loaded trailer will be free to swing when the truck makes a 90° turn. There are two pairs of clamps for securing, with plates, the spar to the bed of the truck; for this reason there must be two corresponding holes drilled through the bed of the truck, on both sides of the supporting sill; the 16 millimeter (5/8 inches) auger required is size Number 8. When the holes have been drilled and the spar laid into place, the clamps are placed astraddle the spar with the ends through the bed of the truck; then the plates that go with the clamps are so placed under the bed of the truck that they are supported by the sills under the bed. The nuts on the clamps are then tightened.

The weight of this member is 98 kilograms.

B. Abutment Equipage.

12. The abutment sill is a solid steel support 4.70 meters long which has attached to it four side-beam seats and eight balk seats, these latter seats having pins for securing the balk. (See Figure 4). At each end of the abutment sill and also in the middle there is a pair of handles; the stream-side handles on the ends of the sill have rings fastened to them to which the upper and lower lashings of the trestle beams are secured.

The weight of this member is 180 kilograms.

13. The abutment sill is secured to the ground with pickets. (See Figure 5). A picket is 80 centimeters long, 5 centimeters in diameter and is made from round steel rod. One end of the picket is sharp-pointed and the other end is rounded and enlarged.

The weight of this member is 12 kilograms.

C. Trestle Equipage.

14. The trestle transom is a lattice-type steel beam. (See Figure 6). There are openings on both ends for the trestle column and also two hooks to which the rings of the hoist cable are attached for raising or lowering the transom. There is a clamp on each end of the transom for clamping the trestle column to the transom. Also on each end of the transom there are two holes, one above the other, about 14 centimeters apart, for the transom pins. On the top edge of the transom there are four holes for the side beam seats [for saddles] and eight holes for the bulk seats. [for saddles]

The weight of this member is 200 kilograms.

15. The trestle column is a piece of steel pipe four meters long. (See Figure 7). The bottom end has a pointed tip to fit into the trestle shoe and also an elliptical hole for the trestle shoe chain. The trestle column has holes in it at 21-centimeter intervals for receiving the transom pin.

The weight of this member is 80 kilograms.

16. The trestle shoe is placed under the point of the trestle column to prevent the trestle column from sinking into the mud of the river bottom. The hole in the trestle shoe that receives the pointed end of the trestle column, is conical in shape so that it is possible to set the trestle column in a vertical position, even though the trestle shoe itself may be tilted because of the contour of the bottom on which it rests. There is a chain attached to the trestle shoe for fastening the trestle column to it.

The weight of this member is 26 kilograms.

17. The tie rod is placed across the tops of the trestle columns to keep them parallel while the trestle is being set up and also to help right the trestle. When the bridge is completed the tie rod is removed.

The tie rod is a steel pipe, whose closed ends are bent and fitted with studs for fastening it to the holes in the trestle columns. The length of the tie rod is 4.50 meters. Its weight is 20 kilograms.

18. The hoist (See Figure 71) is used for lifting the trestle transom. It consists of a chain-link belt, the nameplate "Yale Pul-lift", and a support bracket permanently attached to it, and its retaining pin for fastening the hoist to the trestle column. On the handle of the hand lever there is a switching lever with which the hoist pulley can be put in the UP position (A), the DOWN position (DN), or in the FREE position (keskiasento) [i.e. middle position]. When the switching lever is in the FREE position, a hand wheel is used instead of the handle of the hand lever.

The hoist should not be run to its limit because the hoist ring frame, on being subject to pressure, can easily get stuck in the pulley case. If it should become stuck, it can be loosened by placing the switching lever in the DOWN position (DN), and then tapping the hoist lever with a piece of timber, at the same time pressing down on the hand lever.

For lubricating the working parts of the pulley, there are four oil openings, with protecting bearings. The oil to be used is light machine oil. For lubricating the brake shims and the fiber brake lining, machine oil should be used but for the lubrication of the sprocket wheel a graphite-bearing grease should be used.

The chain must be kept clean, and oiled with machine oil.

In assembling the pulley, the hoist lever must be so placed that the YALE-nameplate side of it is nearer the chain.

The weight of this unit is 27 kilograms.

19. The transverse lashing is installed to strengthen the trestle transversely. (See Figure 10). It consists of two steel cables (length 15 meters and two meters, respectively), which are joined by a section of chain, which is fitted with a lever-operated chain jack. There is a hook fastened to that end of the chain to which the shorter cable is attached. Each of the free ends of the cables are attached to rings of 17 centimeters in diameter. With these rings, one end of the lashing is attached to the top of the trestle column, and the other is fastened either to a picket driven into the shore, or to a tree; for this latter fastening, the hook on the chain is secured to the ring on the end of the cable.

The breaking strength of the chain and cables is 5,000 kilograms. Its weight is about 30 kilograms.

20. The longitudinal lashing is used to strengthen the trestle longitudinally. (See Figure 11). It consists of a steel cable 4.6 meters long, and a 3.8 meter chain fitted with a lever-operated chain jack. There is a stop fastened to the free end of the cable and one fastened to the free end of the chain, on the last link, for securing the lashing to the top and bottom ends of the trestle columns and to the ends of the abutment sill; this is done on the ends of the trestle column by slipping the stop through the rings of the longitudinal lashing retainer pin and on the abutment sill by slipping the stop through the rings there.

The breaking strength of the chain and cable is 5,000 kilograms. Its weight is 25 kilograms.

21. The longitudinal lashing retainer pin (See Figure 12) is attached to the tops and bottoms of the trestle columns for fastening the longitudinal lashing. It consists of two parts; each part has a ring into which the longitudinal lashing stops are inserted. Its weight is 2.6 kilograms.

22. The side-beam saddle (Figure 13) is placed on the trestle transom for attaching the side-beam to the transom. The side-beam saddle is fastened to the transom with a retainer pin. On both edges of the saddle seat there is a notch for the gunwale retainer pins. On each end of the saddle there is a slot for the hanger hooks.

The weight of this member is 13 kilograms.

23. The balk saddle (Figure 14) is placed on the trestle transom for attaching the balk to the transom. There are three retainer pins on the balk saddle, by which the saddle is attached to the trestle transom and the balk to the saddle. On both edges of the saddle seat there is a notch for the gunwale retainer pins. The weight of this saddle is 7 kilograms.

D. Side-beam Equipage.

24. Side-beams are either 2 meters or 4 meters long. (See Figure 15). By joining them together it is possible to have composite side-beams of 4, 6, or 8 meter lengths. They are steel I-beams 22 centimeters high. On one end of the side-beam there are 2 hanger hooks, a gunwale retainer pin, a coupling rod, the coupling pins, and the seat for the movement limiter. On the other end of the side-beam there is a semi-circular notch for the turnscrew and a hole for the side-beam clamp pin. The side-beam is perforated to reduce its weight.

A 4-meter side beam weighs 130 kilograms and a 2-meter side-beam weighs 73 kilograms.

25. Side beams are connected together with a side beam clamp, (See Figure 16), which consists of 2 plates, and a turnscrew that fastens the 2 plates together. One of the plates has pins in it and the other has holes to receive the pins.

The weight of this member is 34 kilograms.

26. The side beam is fastened to the ponton beams with a hanger (See Figure 17). The lower end of the hanger has a hook which is attached to the ponton beam and the upper end has eyes to which the hanger hooks are attached. There is a turnscrew in the middle.

The weight of one unit is 5 kilograms.

27. The bunk beam is placed on top of the side beams to join the floating spans to each other. The bunk beam is a steel I-beam, whose height decreases from the center to the ends. On the reinforced section of the bottom flange there are 2 holes, into which the side-beam coupling rods fit. There are forks on the ends which guide the stem of the movement limiter. The weight of this member is 75 kilograms.

28. The bunk beam is attached to the side-beam with a bunk hanger. (See Figure 19). The bunk hanger is a steel fork whose pronged ends have hooks for the side beam coupling pins. At the arched end of the fork there is a turnscrew, which has a pressure plate attached to the bottom end; the top end of the turnscrew is square so that the screw can be turned with a key. The weight of a bunk hanger is 10 kilograms.

29. The movement limiter restricts the bending of the bridge at the joints of the spans. It is fastened to the limiter seat on

the side beam with a turnscrew. Reading from the bottom upward, there are the following components on the stem: the spring seat, the spring, the washer seat, and on it the necessary number of washers, which are available in thicknesses of 5, 10, and 20 millimeters. There is a ring with a small sidearm that is threaded for screwing into the stem. This ring prevents the washers from coming off the stem. The weight of the movement limiter is 14.5 kilograms.

30. The guard rail post (See Figure 21) is fitted at its bottom end with a clamping device for fastening it to the upper flange of the side beam, and at the top with a forked end. The guard rail fits into the fork, whose jaws are 12 centimeters long. The stem of the guard rail post is made of steel. The distance from the bottom of the fork to the flange of the side beam is 110 centimeters. The overall length of the post is 125 centimeters. Its weight is 10 kilograms.

E. Balk Equipage.

31. Balk are available in 2-meter and 4-meter lengths. (See Figure 22). They are made of steel I-beams 14 centimeters high. At one end of the balk there is a semicircular notch for the turnscrew on the clamp and also a round hole for the clamp pin; on the other end there is a gunwale retainer pin. The balk is perforated to reduce its weight.

A 4-meter balk weighs 54 kilograms and a 2-meter balk weighs 27 kilograms.

32. The balk are fastened together with a balk clamp (Figure 16), which is similar to a side beam clamp except that it is smaller. The weight of a balk clamp is 11 kilograms.

33. A balk hanger (Figure 23) is used to fasten the balk to the gunwale of the ponton. On the bottom end of the hanger there is a hook which is attached to the ponton beam; on the top end there is a set of jaws which are attached to the lower flange of the balk. There is a turnscrew in the middle.

The weight of one balk hanger is 2.5 kilograms.

F. The Transverse Balk and Clamps.

34. The transverse balk is a steel I-beam 4.18 meters long and 16 centimeters high. It is perforated to reduce its weight. The last hole on each end has its edges rounded to avoid breaking the lashing. The weight of a transverse balk is 87 kilograms.

35. The transverse balk is fastened to the side-beam with a transverse balk hanger (Figure 25). It is a steel fork, whose open end is closed with a latch. At the arched end of the fork there is a turnscrew, which has a pressure plate attached to the bottom end; the top end of the turnscrew is square so that the screw can be turned with a key. The weight of a transverse balk hanger is 18 kilograms.

G. Chess.

36. A chess, which is pine, is 3.20 meters long, 21 centimeters wide and 4 centimeters thick. It is narrowed at the ends by cuts 3 centimeters deep and 20 centimeters long, which form a space for the side-rail lashings. To prevent splitting, the chess are reinforced at each end with rivets that pass entirely through the chess. The weight of one chess is 14 kilograms.

37. An end chess is placed at each end of the span. One edge of the end chess is similar to ordinary chess; the other edge is straight and reinforced with a steel plate. There are holes on the

ends of the end chess for the siderail pins. The weight of one member is 28 kilograms.

H. Siderail Equipage.

38. The deck chess is held fast to the balk with the siderails. Balk serves as the siderail members. The balk pins are inserted into the holes in the end chess.

39. The curb rail (Figure 26) prevents the vehicles from hitting and damaging the siderail lashings. The curb rail is wooden and the same length as the balk that is serving as the corresponding siderail. The roadway side of the curb rail is reinforced with iron. The 4-meter curb rail has 3 grooves for the siderail lashings and the 2-meter curb rail has 2 such grooves. At one end of the curb rail there is a semicircular notch clamp turnscrew and a recess for the clamp plate; at the other end there is a retainer pin which prevents the curb rail from moving longitudinally. When the bridge equipage is loaded or arranged for construction, it is necessary to insure that there is the proper number of curb rails designed for both sides of the bridge; accordingly, one group of the curb rails have their iron sides painted field gray and the other group, whose component parts are of opposite orientation to those of the first group, are painted blue. Each span requires two field gray curb rails and two blue curb rails. The 4-meter curb rail weighs 38 kilograms and the 2-meter curb rail weighs 18 kilograms.

40. The siderail is fastened to the edge balk with a siderail clamp (Figure 27). A siderail clamp is a steel fork, whose open end is closed with a latch. At the arched end of the clamp there is a turnscrew, which has a pressure plate attached to the bottom end;

the top end of the turnscrew is square so that the screw can be turned with a key. The weight of a side rail [redacted] 4 kilograms.

I. Hinge Span Equipage.

41. A hinge span balk is a steel I-beam 6.45 meters long, whose height decreases from the center to the ends; it is perforated to reduce its weight. The hinge span balk is placed on the hinge span, always 8 abreast, with one end resting either on the abutment sill or the trestle transom, and the other end resting on the floating sill placed on the deck of the floating span. That end of the hinge span balk that rests on either the abutment sill or the trestle transom, is tapered so that it will fit into the balk seats; this same end is also fitted with holes for fastening it to the seat with pins and the lower flange is also fitted with pins in the same manner as ordinary balk. On that end of the hinge span balk that rests on the floating sill, there is a plate welded between the flanges; through this plate and through the necked-out section of the end of beam, there is a hole for inserting the pin which attaches the hinge span balk to the floating sill; on this same end, the bottom flange is bent down so that the hinge span balk will rest positively on the floating sill even though its angle changes. The weight of one hinge span balk is 152 kilograms.

42. The floating sill (Figure 29) is an angle iron (beam) 2.84 meters long, which is placed upon the deck of the floating span to support the lower flange of the hinge span balk; it is perforated to reduce its weight. At the places on the sill where the hinge span balk rest, there are plates with holes welded to the sill; the hinge span balk are fastened to these plates with pins. The weight

the top end of the turnscrew is square so that the screw can be turned with a key. The weight of a siderail clamp is 4 kilograms.

I. Hinge Span Equipage.

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42. The floating sill (Figure 29) is an angle iron (beam) 2.84 meters long, which is placed upon the deck of the floating span to support the lower flange of the hinge span balk; it is perforated to reduce its weight. At the places on the sill where the hinge span balk rest, there are plates with holes welded to the sill; the hinge span balk are fastened to these plates with pins. The weight

of the floating sill is 58 kilograms.

43. A deck panel (Figure 30) is fashioned from three chess, which are fastened at the ends to carrying plates, which have two hand-holes each. The length of a deck panel is 2.86 meters, the width is 64.5 centimeters, and the thickness of the chess used in the panel is 5 centimeters. The weight of a panel is 65 kilograms.

44. A deck ramp (Figure 31) is a wooden ramp of triangular cross-section, which is reinforced with iron; it is used to join together the hinge span balk and the deck of the floating span on which the ends of the hinge span balk rest. Its pointed edge is reinforced with iron in the same manner as the end chess. The length of a deck ramp is 2.88 meters, the width is 50 centimeters, and the height is 17 centimeters. The weight of a ramp is 60 kilograms.

J. Anchorage Equipment.

45. Anchors are used to steady either a bridge span or a detached ponton against the effects of wind and current.

The middle section is known as the shank. At the bottom end of the shank, the anchor branches out into two arms with flukes. At the lower end of the anchor there is a ring for attaching a marker buoy line and at the upper end of the anchor there is a ring for the mooring line. The stock, which is locked to the shank with a collar, increases the holding strength of the anchor and makes it easier to raise. The weight of one anchor is 65 kilograms.

46. The anchor cable is a steel cable 100 meters long and 10 millimeters in diameter. At each end of the anchor cable there is a ring clamp by means of which the cable can be attached to the

anchor mooring line, to the capstan, or to another cable. The weight of an anchor cable is 40 kilograms.

47. The reel is designed for the anchor mooring cable (Figure 32). The reel is a drum made of galvanized iron, with handles for turning it. There are holes through the center of it for the axle. The weight of a reel is 6 kilograms.

48. The reel case (Figure 33) is used for operating, storing, or transporting the anchor cable reel. The case is open; its length is 65 centimeters, its width is 40 centimeters, and its height 48 centimeters. A wooden axle is fastened to the box with a chain; there are notches 4 centimeters wide on the upper edges of the long sides of the box for the flat ends of the axle to fit into. On each end of the box there are two oblong holes, one above the other, for use as hand-holes during handling of the box. There are four drain holes in the bottom of the case.

When the case is used for storing or transporting the anchor cable, the anchor cable (on the reel) is placed on the bottom of the case, and the reel axle is placed in the case. When the anchor cable is to be used, it is lifted out of the case, and the axle is placed through the center of the reel and secured with a chain; then the reel is so placed that the ends of the axle fit into the slots on the upper edges of the case, thus allowing the reel to rotate freely. The weight of the reel case, including the anchor cable and the reel, is about 70 kilograms.

49. The marker buoy cable (Figure 34) is a steel cable 15 meters long and 7 millimeters in diameter, having a ring clamp on each end for securing the cable to the marker buoy, to the marker

buoy ring on the anchor, or to the anchor cable itself. When not in use, it is stored by winding it around the marker buoy. The weight of a buoy cable is 4 kilograms.

50. A marker buoy (Figure 35) is a wooden block one meter long, 20 centimeters in diameter, and painted red and white. There are two rings on the buoy fastened to it with bolts. One end of the marker buoy cable is fastened to one of the rings (during use) and when not in use, the marker cable is wound around the buoy and the other end fastened to the second ring. The weight of a buoy is 20 kilograms.

51. A capstan (Figure 36) is used when a bridge span or a detached ponton cannot be otherwise controlled in a swift current or when it is necessary to raise an anchor that is stuck too tightly on the bottom. It consists of a drum, the sprocket inside the drum, the axle, and the attached cranks. For ease in handling it is possible to detach the drum. To fasten the capstan to the ponton, it is first necessary to secure the support bracket of the capstan to the last oarlock holes in the bow, using wing nuts. The support legs of the capstan base are attached to the support bracket with bolts. In front of the capstan, it is supported by the support arm, which is fastened on one end with a bolt to the seat in the bottom of the ponton, and on the other end to the front edge of the capstan base. The capstan weighs 46 kilograms, the support bracket 6 kilograms, and the support arm 1 kilogram.

52. The antifriction roller is used on the bow (or stern) gunwale to help guide the anchor cable or to reduce the wear on a steel cable. It is inserted in holes in the bow (or stern) gunwale and locked to the gunwale with cotter bolts. It weighs 10 kilograms.

K. Ropes, Cables, and Lines.

53. Lines may be either steel cable or fiber rope. The dimensions and breaking strengths of the various lines are given in the following table:

Name	Type	Length, meters	Diameter, millimeters	Weight, kilograms	Breaking strength, kilograms
Anchor line, and towing line[1].	Steel	100	10	40	5100
Marker buoy line.[1]	Steel	15	7	4	2250
Mooring line	Manila[2] hemp	15	20	4.5	2850
Guy line	Manila[2] hemp	6.5	14	1	1300

Notes: 1. An eye on each end and on it a ring clamp.
2. Or Sisal hemp.

L. Propulsion Equipage.

54. An oar is 4 meters long. Its parts are: the handle, the shaft, and the blade. The blade is attached to the shaft with bolts. The tip of the blade is strengthened with a ferrule. The weight of an oar is 8 kilograms.

55. An oarlock consists of a shaft and a fork. At the end of the shaft there is a catch which prevents the oarlock from rising during use. The weight of an oarlock is 1 kilogram.

56. The 6 oarlocks are put into the oarlock bag for storage. The length of a bag is 1 meter, the width 35 centimeters, and to its mouth are attached two lines 2.5 meters long and 10 millimeters in diameter.

The oarlocks are all placed into the bottom of the bag before it is folded at all; then this bundle is placed on the ponton cross-beam and the open end of the bag is wrapped tightly around the beam and the bundle. Then this package is tied fast with the lines that are attached to the mouth of the bag. The bag is made of tarpaulin. The weight of a full bag (6 oarlocks) is 6.2 kilograms.

57. Boathooks are of two different sizes: large and small.

A large boathook is used when it is desired to catch a hold from a ponton or a bridge section, or when poling.

Its length is 5.5 meters, and its diameter at the center is 6 centimeters. The hook and the point of a large boathook are blunt. For use in sounding, the boathook is marked off, beginning at the hook end of the pole, in 50-centimeter sections.

The weight of a large boathook is 6 kilograms.

The small boathook is used in handling wooden objects in the water (not to mention bridge equipage).

Its length is 4 meters and its thickness at the middle is 4.5 centimeters. The hook and the point of a small boathook are sharp. The weight of a small boathook is 3 kilograms.

M. Pusher-engine and Assault Boat Equipage.

58. The pusher-engine m/34 (as it is called in the Pusher-engine Manual) is used in transporting a detached ponton, a bridge span (a raft), or an assault boat. When used on a ponton (or a bridge span) it is attached to the stern by inserting the support pins into the second roller holes; in the assault boat is attached to the pipe on the stern cross-walk. The engine develops 30 horsepower, its length is 4.04 meters, and its greatest width is 80 centimeters. In the front section of the engine there is a 16-liter gasoline tank and a 3-liter oil tank. The rate of fuel consumption is 13 liters per hour, and running constantly, a tankful of fuel will last about 1 hour and 15 minutes; a tankful of oil will last 50-60 hours. Among the items included in the accessory equipment of the pusher-engine are: a 15-liter gasoline tank, a 4.5-liter oil tank, a cover for the engine, tool box No. 12, a marker buoy and its cable which is attached, during use, to the starboard intake pipe, and for starting the engine, a crank, which is made fast to the base with a light line. The weight of an engine is 132 kilograms.

59. The pusher-engine cover is an oval-shaped bag made of canvas, which is open at one end and split down one side, which is pulled over the engine to protect it from rain and dirt. At the mouth of the bag there are two lines attached (length: 1 meter, and diameter 8 millimeters), which are used to tie the mouth of the cover around the engine. The cover must be used when the engine is being carried on its rack. The weight of the cover is about 2 kilograms.

60. An assault boat is a clinker-built boat whose bottom is V-shaped and stern flat; its overall length is 5.50 meters, its greatest width is 1.90 meters, the height of the side in the stern is 45

centimeters and in the bow 69 centimeters. There is a keel 3 centimeters high on the bottom, which makes the overall height 72 centimeters. In transporting the boats, it is possible to put one boat inside another in such a way that the bottom of the inside boat butts against the rail that is attached to the side ribs of the outer boat; when two boats are thus arranged, about centimeters of the inside boat is visible. When the boat is carried with the bottom down, it is grasped by the railing inside the boat.

For attaching the mooring lines, there are two mooring rings on the bow of the boat and 2 mooring rings in the stern (at the corners of the sides and the cross-walks). A 13-millimeter diameter hole is drilled through the sternpost for attaching the engine mount. The sides and the cross-walk are fastened together with tubing. On the outside of the cross-walk, and in the middle of it, there is a ring into which the supporting pin of the engine is placed when the engine is attached to the boat. For rowing there is a hole in the gunwale on each side, into which the oarlocks are placed. The position of the thwart is indicated by white paint on the sides of the boat. To protect the bottom of the boat inside, removable floor boards are placed on the bottom; at the union of the keel and the bottom and the sides, an iron band is placed along the corners for protection.

The following equipment belongs with an assault boat: 3 oars, 1 small boathook, 1 engine mount, 3 lines for mooring (1 in the bow, and 2 in the stern), 1 thwart and 1 bailing scoop.

The weight of an assault boat when dry is about 250 kilograms, but after being soaked in the water it is somewhat over 300 kilograms.

61. The engine mount (Figure 37) is attached to the assault boat by means of a wing nut, when the assault boat is to be used for pushing a bridge span (or rafts). In pushing bridge spans the assault

boat contacts the end of a balk on the 4.5 ton span, the center of the stern of the middle ponton when pushing a 7 ton span, and when pushing a 12 ton span it contacts the center of the sidebeam clamp. The engine mount is a beam 65 centimeters long, 15 centimeters wide and 5 centimeters thick. At the bottom, in addition to a bolt with a wing nut, there is also a notched board, whose slot corresponds in shape to that of the sternpost. The same kind of notch is made halfway up the mount. On the top of the engine mount there is a semicircular notch which is lined with rubber and used for firing a machine pistol or small caliber rifle. On that side of the engine mount that the notches are, there are 4 double-sided iron hooks (semicircular in cross-section) which are used for fastening the lines; on the opposite side of the engine mount there is a rubber covering.

The weight of an engine mount is 8 kilograms.

62. The pusher-engine carrying rack is intended for use when the assault boat and the pusher-engine are being transported by truck, and also in temporary storage areas. It is a wooden rack 4.20 meters long, 1.80 meters wide, and 74 centimeters high.

The frame of the rack consists of 2 4.20-meter bolsters which are joined at the ends by cross-braces 1.80 meters long. In the front section of the rack there are 3 bunks and in the rear section 2 bunks; the engine cylinders fit into the spaces between the spacer blocks attached to these bunks. In addition, there are on the bunks, iron plates with holes in them into which the engine trunnions are inserted. On each end of the rack there is an engine sill has 1 and the rear sill 2 iron lugs for supporting the propellor end of the engine. In addition there is on the front sill a lug 64 centimeters high and on the rear sill a lug 56 centimeters high; into the notches of these lugs are placed shafts 3.96 meters long for supporting the boat in

loading. On the sides there are boards into whose spaces the gunwales of the bottom boat fit. In the front end there are projecting guides on the edges and in the rear there are shoulders to support the boat.

The weight of a rack is 190 kilograms.

N. Marking, Measuring, and Guiding Equipment.

63. A line stake is a spruce pole 3 meters long. At the bottom end there is a conical ferrule and at the top there is a tubular ferrule, which has a slit in it for attaching the marker lantern to it. The stake is painted red and yellow; the length of each color section is 30 centimeters. The weight of a stake is about 3.5 kilograms.

64. Marker lanterns and illumination lanterns are so-called storm lanterns. They have handles from which they may be hung. Marker lanterns are either red or white. They shine only over an angle of 60°. Illumination lanterns, however, project their light in all directions.

Marker lanterns are used to indicate bridge lines, anchor lines, the bridge head, bridge spans, or shoals. Illumination lanterns are used in rescue work, loading or unloading bridge equipage and for other work. The overall height of a lantern is 25.5 centimeters, the height of the glass and the diameter is 80 millimeters, the diameter of the fuel reservoir is about 13 centimeters, and holds about 0.35 liters. A supply of fuel will last 15-20 hours. Its weight is about 0.55 kilograms.

65. A two-meter measuring rod is marked off in 10-centimeter calibrations. Its weight is about 1 kilogram.

66. A measuring line (Figure 38) is a steel cable 120 meters long, and 5 millimeters in diameter, which is fitted with 5-meter scale

marks. At each end of the line there is a ring 10 centimeters in diameter for handling the line and for fastening it. At the zero end of the line there is a 2-meter long steel cable with a hook on the free end for attaching the line to a measuring stake or to a tree. The line is stored on a wooden reel. The weight of the measuring line and reel is about 10 kilograms.

67. A marker (Figure 39) consists of a shaft 60 centimeters long to which a circular plate 20 centimeters in diameter is attached; the circular plate has a solid red circle 10 centimeters in diameter painted on a white background, on both sides. Its weight is about 0.5 kilograms.

68. The megaphone is made of galvanized steel plate. It weighs about 0.6 kilograms.

C. Other Equipage for the Pontoon Bridge.

69. A roller beam is used as a roller when it is placed on one balk length to move another balk length into place, and is used as a guard rail on rafts whereby it is placed across the raft and fastened to the longitudinal guard rails on which it is allowed to rest. The roller is wooden, 4 meters long, and has a diameter of 10 centimeters. It weighs about 20 kilograms.

70. A grapnel is used for dragging for the anchor and the anchor line. It might be described as an anchor with a short shank to which 3 arms are attached; at the upper end of the shank there is an anchor mooring ring. In the middle section of each arm there is a small 3-armed anchor, so that there is a total of 12 arms on the grapnel. A grapnel is made of steel and weighs about 12 kilograms.

71. A pump is used for removing water from pontons. By construction it is a lift pump; when the piston is rising, during which time the valve at the bottom of the cylinder is closed, water is taken in and on the return stroke of the piston the water is allowed to pass through a valve into the upper section, from which it is forced out of the pump on the next stroke and allowed to run out of the chute. The pump cylinder, the chute, and the piston rod are wooden. The piston is made of belting material and the valve is made of shoe leather. The pump is long enough to make it possible to pump water from the bottom of the ponton over the side. It weighs about 8 kilograms.

72. The leveller is used for raising the level of a loaded ponton raft to that of a floating dock, for unloading and also for lowering back into the water (after the bunks have been removed). The shaft of the leveller is a bent section of U-iron 1.65 meters long, which has a wheel at one end and at the other, a support bracket for attaching it to a beam and a bearing to which the support of the trestle hoist is attached. A steel cable is set tightly on the pulley wheel; on one end of the cable there is an attaching tube which is placed under the rail of the ponton being lifted; at the other end of the cable there is a hook to which the ring of the trestle hoist is placed when the leveller is used. The diameter of the steel cable is 8 millimeters. The weight of the leveller is about 24 kilograms.

73. The tarpaulin used for the transport vehicles of the bridge company is 4.5 meters long and 2.4 meters wide. There are lashings on the edge of the tarpaulin as follows: one at each corner, 2 on each of the long sides, and one on each of the short sides. The length of each lashing is 1.20 meters and the diameter is 10 millimeters. The weight of a tarpaulin is 7 kilograms.

74. The following additional equipment, among other things, is included in ponton bridge equipage: in tool chest No. 4, a sledge hammer (weight about 7 kilograms), and in tool chest No. 8, two augers (diameter 16 millimeters) and repair tools.

Definition of a "seka" span:

The "seka" span, like the hinge span, is used to connect the fixed section of a bridge with the floating section. On the shoreward end of the span, the "seka" span is the same as the hinge span, in that both of them may be supported by either an abutment sill or a trestle transom. The two spans differ on the off-shore end, however. The hinge span rests on the deck of the floating span; the "seka" span rests on a floating sill.